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Gains in 1970's came the hard way

For U.S. chemical industry, the seventies couldn't match sixties for growth in jobs and output, but profitability firmed, foreign trade soared

William F. Fallwell
C&EN, New York

The 1970's won't soon become a mine for nostalgia buffs, who right now are dwelling on almost any other period.

A hard-nosed reversal of the 1960's, the seventies brought roller-coaster economic cycles and pruned the rewards mainly to those of discipline and, at times, a bit of luck. Fortunately, the U.S. chemicals and allied products industry got at least its share of the latter, according to C&EN surveys of vital economic indicators over the past 20 years.

Although the seventies had their grinding aspects for U.S. chemicals, the decade finished better than it began in some important respects, notably in profits, plant use, and foreign trade. These improvements promise some good years in the early 1980's after a likely pause for recession in 1980 itself.

It all depends on one's point of view. On the people front, the chemical industry hardly expanded at all in the 1970's except in special categories of women, minorities, and scientific and technical professionals. However, even for women and research and development professionals, employment growth ran at just half its rate for the previous decade.

For plant personnel, who hold nearly three of every five jobs in the chemical industry, the 1970's saw virtually no employment growth. Since the workweek was also stationary, these employees had to become more efficient. This shows up in a rate of productivity gain surprisingly close to gains in the 1960's. However, wages really took off in the 1970's, resulting in steadily increasing unit labor costs compared to the declines of the previous decade.

On the product front, the 1970's, as expected, trimmed the rate of output growth in nearly every major category. The decade also brought a stern downward adjustment in development of new products and processes in favor of an intense campaign refitting present products and processes for greater safety, less pollution, and energy savings.

Even so, some products grew surprisingly well in the seventies. The star of the decade indisputably was plastics. Despite the Organization of Petroleum Exporting Countries, U.S. government regulation, and an image problem, plastics grew nearly as fast as they did in the sixties.

With moderate growth generally in its products, no growth in employment, and a strong efficiency drive in many directions, the chemical industry certainly stood a basic chance of improving its financial performance. And that's exactly what happened, although some stiff challenges made the outcome uncertain at times. The worst challenge was drastic increases in the cost of everything, including money.

The chemical industry had come through the sixties with a tradition of absorbing higher costs through efficiency gains. In fact, companies steadily lowered product prices. The raging inflation of the 1970's put this tradition to an impossible test. However, the chemical industry managed to swallow the cost bulge without hurting profitability by increasing product prices about in line with general inflation.

As a result, the industry ended the steady erosion in profitability from the 1960's. In the seventies, profits

Growth in the 1970's was less than in 1960's except in inflated money figures, foreign trade

U.S. chemicals and allied products	Annual averages			Average annual change, %	
	1979	1969	1959	1970–79	1960–69
PEOPLE					
Employment, thousands					
Total	1112	1060	809	0.5%	3%
Production employees	637	622	506	0.2	2
Women	270	220	151	2	4
R&D professionals	49	40	32	2	4
For production employees					
Hourly wage	$7.56	$3.47	$2.40	8	4
Workweek, hours	41.8	41.8	41.4	0	0.1
Total weekly workhours index (1967 = 100)	108.2	105.5	84.9	0.2	2
Productivity index (1967 = 100)	194.5	112.2	64.0	6	6
Unit labor costs index (1967 = 100)	125.4	99.7	120.9	2	−2
PRODUCTS (indexes, 1967 = 100)					
Chemicals & allied products	210.5	118.4	54.3	6	8
Basic chemicals	189.9	117.0	58.0	5	7
Alkalies, chlorine	129.8	115.1	76.1	1	4
Organics	231.2	125.3	48.8	6	10
Inorganics	133.1	97.6	70.4	3	3
Synthetics (polymers)	319.9	141.2	43.5	9	12
Plastics	416.7	148.6	46.7	11	12
Rubber	131.3	117.7	74.0	1	5
Fibers	271.0	139.8	36.1	7	14
MONEY, $ billions					
Sales (worldwide)	$170	$ 56	$ 26	12	8
Profits	$11.3	$3.6	$ 2.1	12	6
Profit margin on sales	6.6%	6.4%	8.1%	—	—
Product price index (1967 = 100)	222	100	102	8	−0.2
Capital spending	$8.5	$3.1	$ 1.2	11	10
R&D spending	$3.9	$1.7	$ 0.8	9	8
Foreign trade					
Exports	$17.0	$3.4	$1.6	17	8
Imports	$7.3	$1.2	$0.5	20	9

Sources: Commerce Department, Labor Department, Federal Reserve Board, Federal Trade Commission, National Science Foundation, C&EN calculations and estimates

grew about in line with sales. One help was a rate of real-dollar new plant investment much lower than in the 1960's. This brought plant use into a more desirable range as the 1970's closed. A second big help was a boom in foreign trade greatly favoring U.S. exports. The U.S. finished the decade as the most attractive area of the world for making chemicals.

All in all, the seventies may have come out well in the end for the chemical industry. But this kind of progress was a far cry from the growth-oriented smooth sailing of most of the sixties. In a way, the seventies brought the industry to grips with a number of basic problems that could not be ignored under tougher economic and regulatory circumstances.

Statistics from various government sources show how the chemical industry tightened up in response to a stormier business climate, and the heavier hand from Washington. The biggest change in the growth of its resources was in people. From an average 3% gain per year in the 1960's, chemical employment slowed to a 0.5% average increase in the 1970's, winding up at 1.11 million in 1979 compared to 1.06 million in 1969. For production employees, the drop was from 2% per year to 0.2%, leaving their ranks at 637,000 in 1979 after 622,000 in 1969.

Smaller groups fared better. Chemical employment for women grew 2% per year in the 1970's compared to 4% in the 1960's. But since total employment hardly budged, women increased their part of the total to 24% in 1979 from 21% in 1969 and 19% in 1959.

For scientists and engineers in R&D, jobs (in terms of full-time equivalents) grew 2% per year in the 1970's after 4% in the 1960's in chemicals and allied products. These employees numbered about 49,000 in 1979, C&EN estimates, compared to 40,000 in 1969 and 32,000 in 1959. Hence, their part of the total chemical workforce picked up to 4.4% in 1979 from 3.8% in 1969 and 4.0% in 1959. The gains in the 1970's came more in the second half than in the first few years and continue rather well at present.

Since these professionals' salaries take up about half of R&D support at chemicals and allied products companies, R&D budgets had to grow substantially in the 1970's. C&EN estimates companies' R&D spending in 1979 at $3.9 billion, more than double spending of $1.7 billion in 1969 and nearly five times spending of $800 million in 1959. Average annual budget growth in the 1970's was 9% after 8% in the 1960's. With inflation removed, this growth left a small margin of real-dollar gains, about 1 to 2% per year in the 1970's. As in past C&EN surveys, this real-dollar growth corresponds closely with growth in employment for R&D professionals.

Even this modest increase in jobs looks like a lot compared to the employment at chemical plants. One major disincentive was the big increase in labor costs unmatched by productivity gains. In this respect, the seventies were the reverse of the sixties. Although productivity (physical output per workhour) gains averaged 6% per year in both decades, hourly wages shot up 8% per year in the seventies following 4% in the sixties. Hence, unit labor costs (cost per unit output) rose 2% per year in the 1970's after falling 2% per year in the 1960's.

Another reason plant employment idled in the 1970's was that production and real-dollar new-plant investment both toned down from the 1960's. For the broad chemical industry, production rose 6% per year in the more recent decade compared to 8% in the sixties.

In basic chemicals, growth was 5% per year in the 1970's compared to 7% in the 1960's. The only reason growth held up even this well was a 6% annual clip in output gains for organics in the 1970's. Alkalies and chlorine sank to a 1% annual gain, and inorganics plodded along at an annual rate of 3%.

The best source of growth for chemicals in the 1970's was through downstream polymers, especially plastics. Polymers as a whole grew 9% per year in the 1970's compared to 12% in the 1960's. However, plastics nearly equaled their decade-earlier growth, down just one percentage point to 11% per year in the 1970's. Fibers' growth rate fell by half in the 1970's to 7% per year. For rubber, the seventies were a rough time, with growth just 1% per year after 5% in the sixties.

Chemical companies adjusted their plant investment quite well in line with the reduced rate of product growth. Official capital spending budgets rose 11% per year in the 1970's after 10% in the 1960's. However, inflation reduced average real-dollar growth in new plant and equipment to 3% per year at the most in the 1970's. And actual net increases in new production capacity were probably less than that because of a widespread tendency to use more capital funds for refitting old plants than in new construction.

As a result, plant efficiency and use rates today are much better generally than in 1969. Although the next decade may well start with a recession as did the 1970's, the chemical industry may not have to wade through a soft market spell for as long as it did 10 years ago.

Chemical profits are showing the effects of better plant use. For the 1970's, after-tax profits in chemicals and allied products rose an average of 12% per year, reaching $11.3 billion in 1979 after $3.6 billion in 1969 and $2.1 billion in 1959. Although annual profits growth was just 6% in the 1960's, the difference in the growth rates is due almost entirely to inflation. Real-dollar profits growth in both decades was about 4%.

Profits growth in the seventies caught up with sales growth, which also averaged 12% per year. Sales had climbed a vigorous 8% per year in the less inflationary sixties, well ahead of the profits pace. Hence, the profit margins on sales in chemicals and allied products edged up a bit in the seventies, ending with about 6.6% in 1979 compared to 6.4% in 1969.

Although the chemical industry can trace much of its profits firming in the seventies to bootstrap efforts in efficiency, the industry also got a major lucky break in foreign trade, and from a surprising source. Although the industry at the time had great misgivings about OPEC's dramatic increase in the oil price in 1973, the new price structure for world hydrocarbons turned out to be a bonanza for U.S. chemicals. Since imported oil accounted for only a quarter of the industry's feedstock and energy costs as late as 1978, the industry was much more shielded in such cost increases than were competing industries in Europe and Japan.

As a result, U.S. foreign trade in chemicals mushroomed in the late 1970's, reaching an estimated $17 billion in exports and $7.3 billion in imports in 1979. These figures are up a resounding 17% per year in exports and 20% in imports from 1969. In the sixties, the corresponding growth rates were 8% and 9%. By 1979 U.S. chemical exports accounted for 10% of total sales, up from 6% in 1969 and 1959.

Although this trade advantage is not expected to last indefinitely, the U.S. chemical industry is still under stronger control now than in 1970. In 1970, no one suspected the degree of disciplining about to hit the industry after its heady expansion days. In 1980, some in the industry are contemplating what might happen if the stringent conditions of the decade just ended eased even slightly in the years ahead. Even if strictures continue, the general feeling now is, "We're ready." □

White House innovation plan off and running

Called meager by critics, Administration's technology policy spans several agencies, integrates programs; more legislation and newer policies planned, but does new program meet today's realities?

Wil Lepkowski
C&EN, Washington

Everyone who followed the Carter Administration's 18-month Domestic Policy Review on technological innovation knows that Uncle Sam declined to bring industry the gifts it most wanted.

Indeed, as one official in the Office of Management & Budget put it to C&EN, the President opened up his technology policy bag and out ran a mouse. The consensus around Washington has been that the "initiatives" were philosophically and fiscally pale—in fact, minor.

"The Administration," said former assistant Commerce Secretary Betsy Ancker-Johnson to a Senate hearing in November, "has thoroughly discredited itself as a leader in the development of technology policy." Now vice president for environmental activities at General Motors, Ancker-Johnson says that Carter failed to deliver on the issues that mattered most to big and small business—reform of antitrust policy to make joint ventures easier, restructuring tax policy to loosen investment capital, and redesigning regulatory policy so industry can spend more time doing research and development instead of paying excessive compliance costs.

On regulatory policy, Ancker-Johnson wasn't quite right, but she can hardly be blamed for chomping at the bit. When she was assistant secretary for science and technology four years ago, she put together a framework for technology policy, and her successor, Jordan J. Baruch, proceeded to act as if it had never been done.

But successive Administrations often act that way, especially if the political parties differ.

Nevertheless, the severest of the critics say that Frank Press, White House Science Adviser, and Baruch wasted valuable time. They believe that Baruch, whose assistants Theodore Schell and Frank Wolek ran the review, focused on making his own unique contribution rather than on the work of simply delivering a synthesis of studies done before, plus an agenda for a Presidential action program.

Thus, these critics say, the review revealed nothing new, and even the claim that the national consciousness was raised over the importance of the issue held only drops of water. Indeed, the backing of the Chrysler loan by the Administration was testimony enough that noninnovative, poorly productive companies, when big enough, will be propped up and bailed out when about to die a natural death. Some critics wonder whether Carter was listening to his own science and technology message.

Furthermore, the critics say, Press and Baruch failed to put the issue of innovation in a global and strategic perspective. They feel the program should have been more dramatically tied to an articulation of problems facing the country in the 1980's—trade crises, fuel shortages, raw materials scarcity, financial and monetary stresses affecting technological and raw materials investments, capital shortfalls, and increasing social malaise. Innovation for an economic system undergoing basic structural change, they say, was the kind of message the more thoughtful were waiting for. But they didn't get it and they felt cheated.

But the facts are that the Domestic Policy Staff, which is to say Stuart Eizenstat, didn't really want anything too broad or too fiscal. It wanted a limited debate. It ranged across agency programs but it was in reality a study along a narrow waveband, narrowed even further by leaving out important policy options.

The gaps led Rep. Charles A. Vanik (D.-Ohio) to comment: "The Administration plan gives no incentives that are going to work. I'm concerned about our tremendous erosion of our technological base. In the 1980's technological leadership will be essential for survival on all fronts, domestic and foreign."

Vanik: no incentives that will work

Vanik is the third-ranking member of the House Ways & Means Committee, where all tax legislation begins. He appears to have gotten innovation fever and is sponsoring a bill, H.R. 5881, that would establish tax credits on portions of an industrial fund that would go to research and development in universities. His bill is one of several innovation bills floating around Capitol Hill.

"The whole [Domestic Policy Review] thing was overblown," says a staffer at the office of Management & Budget. "We just didn't have a hell of a lot to offer these people. We all know Charlie Schultze [chairman of the Council of Economic Advisors] has been concerned a long time about making tradeoffs between environmental regulation and economic

The Administration's technological innovation effort has 15 major programs

Program	Center for Utilizing Federal Technology	Foreign technology utilization	Generic technology centers	Regulatory technology development	Better industry-university cooperation in R&D	Uniform government patent policy	Upgrading of Patent & Trademark Office
Agency	National Technical Information Service, Department of Commerce	NTIS	Department of Commerce (three centers); National Science Foundation (one center)	Office of Management & Budget, overseeing regulatory agencies or Productivity Council	National Science Foundation	Office of Science & Technology Policy	Patent & Trademark Office
Contact	Melvin Day (703) 557-4636	Melvin Day (703) 557-4636	Commerce: Francis W. Wolek (202) 377-3966; NSF: Robert Colton (202) 634-6204	Undecided but try Phillip Smith, OSTP, (202) 395-6244	Robert Colton (202) 634-6204	Phillip Smith (202) 395-6244	Patent Commissioner Sidney A. Diamond (703) 557-3071
Purpose	New, improved ways of informing industry of inventions in federal laboratories	Collect and disseminate information on foreign, potentially innovative technologies	Industry/government-funded centers to upgrade broad, basic technologies	Improve innovation in regulatory compliance technology	Help universities understand style and scope of industrial research, train students better for careers in industry	Give companies exclusive licenses to develop government-owned inventions. Would be governmentwide policy	Further automation of filing, classification; establishment of single count only for patent appeals; re-examination of issued patents on request
Fiscal 1981 funding	$1.2 million	$4.2 million	$6 million to $8 million	—	$20 million	—	Not determined
Comment	NTIS will hire several writers and analysts to produce interpretive material. Effective implementation, extension, could cost much more than proposed $1.2 million	Translations of foreign literature ($1.8 million). Funding probably insufficient. Part two ($2.4 million) involves federal debriefing of visitors to foreign countries. Could take years to produce relevant information	Generic technologies include welding, corrosion prevention, lubrication. NSF supports several such centers and reports success. A favorite scheme of Jordan Baruch	Most agencies (OSHA, FDA, EPA) have long been made conscious of promoting best and most efficient technology. Big need is experienced staff of agencies	Said to be one of best-run NSF programs. Plans to extend program to other agencies with goal of $150 million total	A long-sought program often thwarted by public interest groups and populist politicians. Outlook fair, but opposition will fight. Will require legislation	Chances good. Senate and House behind proposals. Legislation already introduced in Senate

growth. We're already doing something about that. Taxes we couldn't do anything about because the Administration didn't want innovation to get mixed too heavily too early with next year's tax package."

It is generally felt that Baruch did not get all he wanted after his document went up to the White House Domestic Policy Staff last summer. Al Stern, the Domestic Policy staff aide in charge of administering the review, says Baruch initially wanted some commitments at least to altering tax policy for releasing a flow of funds that presumably would go to innovation. But DPS wanted a narrower focus, Stern tells C&EN, fearing that any commitment to tax policies would branch out into fields outside innovation.

"We just don't think tax measures are a major stimulant to innovative activity at this junction," he says. "We think there's going to be a downturn, we don't know when, and we certainly don't feel we want to accelerate the inflation problem."

There is the possibility, Stern believes, that much of the innovation lag industry complains about may be self-induced, too. "Industry has a great deal of conservatism in its own house," he says. "There's a large amount of restraint on the management side, and that could depress innovative activity. When I hear industry complain about our lack of action, I simply tell them to go out and innovate."

Stern says that when one tries to discover whether there actually has been a dropoff in American industry's ability to innovate, then the measurements become less convincing. This makes the steps, even to the policy's architects, more than a little dubious.

"I have no doubt that accelerated depreciation would have an impact on innovation," Stern says. "But it would have much larger consequences elsewhere. The reasons for accelerating depreciation have to do with much more than innovation. We want to make sure there are no negative impacts elsewhere. We looked at venture capital. And the early returns tell us that venture capital is more plentiful than ever. But it seems to be high only for second stage financing. Seed money is hard to come by. 'Petromoney' isn't used for venture capital because it seems the more there is of it, the less it is used for risky ventures. So the question came down to finding some mechanism for producing seed money for initial financing without making government finance every scheme in the world."

Much of the final Presidential wording was chiseled out by Stern and by Philip Smith, a top aide to Frank Press. Smith, quite naturally, is enthusiastic about the product. He

Office of Small Business Patent Counsel	Clarifying antitrust policy	Small business innovation research program	Corporations for Innovation Development	Federal support for small R&D businesses	Venture capital availability	Opening federal procurement to innovations	Improving government regulations
Small Business Administration	Justice Department, Federal Trade Commission, OSTP	National Science Foundation	Department of Commerce (some NSF help)	Small Business Administration	Small Business Administration	Office of Management & Budget, General Services Administration	Environmental Protection Agency, Food & Drug Administration, Occupational Safety & Health Administration
Milton Stewart (202) 653-6533	Justice: Ky Ewing (202) 633-2562, FTC: Robert Reich (202) 523-1447, OSTP: Phillip Smith (202) 395-6244	Roland Tibbetts (202) 634-6204	Philip Goodman (202) 377-3914	Milton Stewart (202) 653-6533	Milton Stewart (202) 653-6533	OMB: Fred Dietrich (202) 395-6810 GSA: Gerald McBride (202) 566-1043	Call Phillip Smith at OSTP for referral (202) 395-6244
Help inventors convert activities to small businesses by entrepreneurial counseling	Explain antitrust policy to industry more systematically; publish guidebook on antitrust/ innovation for industry	NSF provides venture analysis and feasibility testing support to new firms	Help states give support to new businesses	Give small R&D firms bigger slice of federal grant and contract business	Changes in Small Business Investment Corporations/ Employment Retirement Security Act policies	Policy changes to ease entry of innovative products into government purchases. Small business will be given preference	Substitution of performance for design standards; five-year forecasts of priorities. Clearance based on innovativeness of product
Negligible	Negligible	$10 million above current $2.5 million	$8 million ($4 million per center)	Negligible	—	—	—
Universal approval	Industry chronically complains that antitrust policies are vague and inconsistent on joint ventures. Wants more flexibility. Justice says it is flexible enough. No policy changes expected	Goal to establish same program in other agencies to goal of $150 million total funding	Legacy of old, defunct State Technical Services Act. Some state programs good, some not so good. British model experience mixed, since British innovation record poor of late	OMB will monitor progress. Will require vigor and verve by Stewart, or whole thrust could be forgotten. Small business groups will need to maintain pressure	Possibly significant. ERISA change was recommended by several industry panels. Much depends on decisions by pension fund managers	Experimental Technology Incentives Program in National Bureau of Standards paved way for this program. Was product of Nixon science and technology message of 1972	Further steps in Administration policy for cutting regulatory red tape, giving industry better means of anticipating regulatory policies, actions

says implementation of even this first step will take two or three years but that the initiative is integrated and long lasting.

Right now, he says, the most spirited activity is around the structure of the bill needed to modernize the patent office.

"For example," Smith says, "we're aware of the inequities of the patent system for chemical and pharmaceutical companies where regulatory compliance holds back the introduction of a new product many years. The patent life by the time the product is introduced is half exhausted, thus reducing the profit rewards the company would get for disclosure of the invention.

"We may come to the point of proposing extension of the patent life," he says, "but we're not at that point yet. Other things need to be done first. An even more fundamental issue is developing legislation to extend the patent system to developments in the life sciences and to computer communication systems."

In six months Baruch is scheduled to deliver to the Domestic Policy Staff a progress report on each of the programs proposed by the President. Meanwhile, technology policy framers in Commerce, the Office of Science & Technology Policy, and DPR will be stepping up what already will be going on.

"We intend to enlarge the generic technology area, provided the four experiments we are proposing don't fall flat," says Stern. "We will look further at the research and development interplay between industry and universities. We'll also be doing work on the tax front, with the good possibility that innovation will claim a whole section of the Administration's omnibus tax bill. We also will want to look at whether there is a regional falloff in innovation patterns, such as between New England and the Sun Belt states. We'll be looking further into the international flow of innovation."

Other possibilities could include a sweeping assessment of innovation needs in what the Administration euphemistically calls a "constraint economy," which means serious recession or depression. "Commerce should be the agency examining that," Stern says. A National Technology Institute along the lines proposed in Sen. Adlai E. Stevenson's (D.-Ill.) innovation bill, S. 1250, is remote but still a possibility. But Stern says that while Stevenson's bill would establish a big overall technological institute, the Administration might tend to envisage institutes of a much narrower focus, such as development of engineering manpower for national needs and technological goals.

The subject is almost too complex

to handle piecemeal much less in an integrated way because of the way innovation covers all aspects of an industrial economy. For example, OMB is nowhere clear on the right type of balance that should exist between federal and private sector funding of new technologies. Some OMB elements doubt whether the government should be involved in any development projects.

"We are now experiencing growing cynicism about the contribution of federal research and development to the economy," says an OMB manager. "By that I mean the idea that if we only tried harder government R&D would solve our problems. We're also again feeling that what we are spending in energy the private sector after all should do by itself. It's hard to know the difference between money for demonstrations and outright subsidies."

It is clear, then, that the debate over innovation will sizzle through the turbulent eighties. Groups at such far poles as the American Enterprise Institute, which speaks for a conservative capitalism championed by Ronald Reagan and John Connally, and the Center for Economic Alternatives, which wants an economy more geared to meeting the needs of the common man, are both developing programs on the subject.

One figure who hasn't been officially heard from in some time is Commerce Department senior economist Michael Boretsky. It was Boretsky who sparked the debate over America's technological competitiveness during the early 1970's, when previous Commerce Secretaries were proposing to then President Nixon a program not far removed from what Carter announced last Oct. 31.

Though ignored by Baruch, Boretsky continues to assemble data and analyses on such matters as productivity, technological economics, and inflation. He is especially concerned about the strategic consequences of a continued U.S. decline in international technology markets and delivered his perceptions on the subject in a speech last year to the Army War College. At the moment, Boretsky's views are not popular among Administration economic policymakers because he believes that U.S. corporations, through their export of technology abroad, are contributing to the erosion of the country's balance of trade and overall strategic balance in the all-important high technology industries.

Transfers of technology—either through the multinationals or through licensing to foreign firms—have a detrimental impact on national security, he says. The net impact, he says, "is adverse effect on the balance of payments and external value of the dollar. This, in turn, affects the country's economic, political, and military posture abroad, including the many strictly defense-oriented installations which the nation maintains overseas," he told his military audience.

Boretsky believes the decline in the country's technological competitiveness contributed to the 1971–73 dollar devaluation "much more than all other factors combined."

He adds, in fact, that "based on my calculations and analysis, I came to a firm belief that had the U.S. done nothing more than it has actually done in promoting new technology at home, but had fostered exports of its products with the same vigor as it fostered export of licensing technology, the kind of deterioration of U.S. trade and balance of payments that we have been witnessing since 1971 might have come eventually, perhaps in the twenty-first century. But not in 1971."

His views are those of Boretsky, the individual, rather than as policy analyst for the government. But they are well-known throughout the Washington technology policy community. He wants Washington's current technology establishment to make an objective assessment of the national security implications of "either the transfers of technology or the emergence and growth of the Eurodollar markets."

Boretsky's views are rather holistic, and here and there rather hawkish in terms of the technological power balance between the U.S. and U.S.S.R. But he believes the U.S. is in deeper trouble than the current science and security advisory apparatus realizes and this has everything to do with innovation.

He would like to see a more strategic analysis of technological balance data provided to the White House. Technology, economics, and security need combined analysis, he says, and the Administration is currently not getting it. "On some developments critical to U.S. long-term security, apparently nothing is supplied at all."

But on the domestic side of technology policy, Boretsky has several suggestions, including:

- Substitute one half of the present investment credits for tax credits and apply them to research and development aimed at technological innovation that would either enhance labor productivity, save materials, develop substitutes for raw materials, save energy, or develop truly innovative new processes and products.
- Reduce or preferably eliminate the capital gains tax on gains stemming directly from investments that go into new enterprises. The secondary gains would be taxed at the present 28% rate. "Such a policy would provide the additional incentives needed in the environment of progressively scarce capital to induce investors to take the larger-than-normal risk of investing in new technical enterprises."
- Besides having the Census Bureau publish its usual data on employment, man-hours worked, value added, etc., for various industries, add to the service data on best and worst performing industries. This would be a managerial monitoring tool leading to steps to improve performance in lagging industries.
- Establish a new Office of Industrial Technology & Productivity Enhancement in the Commerce Department. The office would do technology policy planning, measure the country's technology policy planning, measure the country's technology needs vis-a-vis level of effort, administer a network of university-affiliated centers for industrial technology, and support a network of regional productivity enhancement centers.

It wasn't Baruch's assignment to delve into the national security aspects of technological innovation—broadly or narrowly. The military aspects are left, understandably, to the Defense Department, National Security Council, and the intelligence community. But the nonmilitary aspects of security are fair game, and, in fact, strict focus on "domestic policy" may miss the point entirely.

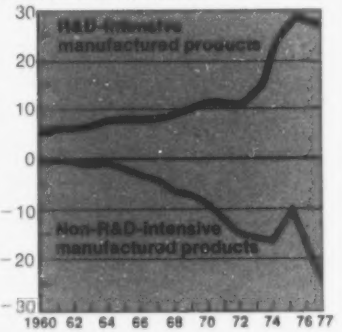
Indeed, William Winpisinger, president of the International Association of Machinists & Aerospace Workers, says the innovation study was a smoke screen. In testimony in November, he said, "The glut of corporate profits—21.2% this quarter—provides unlimited resources for lavish political contributions, extraordinary lobbying expenses, political and business bribery and kickbacks on an international scale, propaganda campaigns, front groups' foundations, and institutional advertising. Yet with all these extracurricular activities, we are asked to believe that the corporate state is having great difficulty financing industrial innovation. The truth is that the corporate state has difficulty financing what the corporate state chooses to have difficulty financing, and it has exactly as much innovation as it wants."

For every Boretsky there's a Baruch. And for every Baruch a Winpisinger. The innovation debate is so complex that its watchers and as-

Why U.S. technology needs a shot in the arm

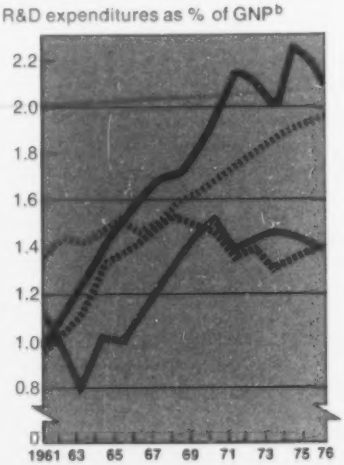
Export of research-intensive products begins to decline . . .

Trade balance, $ billions[a]



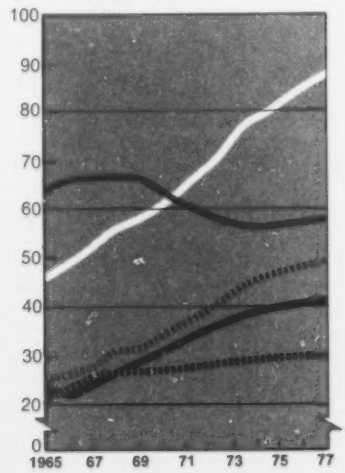
. . . while the R&D/GNP ratio falls below rest of industrial world . . .

R&D expenditures as % of GNP[b]



. . . and number of scientists and engineers also falls

R&D scientists and engineers per 10,000 labor force



U.S.S.R. ····· Japan ——— West Germany
····· France ——— U.S.

[a] Exports less imports [b] Excluding government funds for defense and space R&D.
Source: Science Indicators—1978

sorted fans are turning now to Capitol Hill and a big Congressional Research Service (CRS) study that is slated to sum up everything known and believed about the subject. The study is being coordinated by CRS's Walter Hahn and is part of a voluminous study on economic change commissioned by the Joint Economic Committee.

The study so far indicates that there is no central theory of innovation. Thus, the search usually centers on scapegoats as prime causes for the so-called "lag."

One draft says, "Each finger-pointer has at least one other group to blame: too much government, irresponsible business, big labor, a consumer society, inflation and a faltering economy, or just plain 'them'—anyone from environmentalists to OPEC and from political opposites to foreigners."

Only one group in the country has tried to achieve a holistic perspective on innovation policy. It is the Center for Policy Alternatives under J. Herbert Hollomon at the Massachusetts Institute of Technology. Some ideas generated through that group are important to include because nowhere else is innovation studied more intensely than there.

The aim of innovation, the group contends, is not so much a growing economy but one that responds to change and challenge. It does not believe that government should intervene in the marketplace by supporting technological development in the civilian industrial sector. It believes that government should not brace up firms like Chrysler Corp. that cannot compete any longer. It believes that antitrust law should be enforced so that companies are penalized for not innovating. It believes the U.S. should learn from Japan.

"In no other developed country is there such a complete array of programs to encourage innovation," the center's Christopher T. Hill and James Utterback say in "Technological Innovation for a Dynamic Economy." These include grants-in-aid for the implementation of inventions, special development contracts and grants, arrangements for commercialization of new developments, support for capital equipment for new ventures, rapid tax writeoffs for new developments, low-interest loans for high-technology firms, special analysis and advice for small firms, special procurement policies for small businesses, 'open' research laboratories in all prefectures for the use of new and small firms, and no-interest loans for modernization of small firms. "The U.S. should consider adopting new programs of the kind now found in Japan." they say, adding: "Frequently, it is claimed that the risks of technological innovation are too great today, and that government should take actions to reduce that risk by, for example, subsidizing development of new technologies, weakening the antitrust laws, or rolling back environmental health and safety standards.

"The main message is just the opposite--government should take steps to encourage innovation by increasing the risks that firms face—not by increasing the risk of failure of new technology, but by increasing the risk that a firm will fail if it does not innovate."

The MIT plan, although bold, wouldn't hold much political water. Protectionism is expected to increase, not decrease, during the 1980's. And despite what the studies say about the comparative economies of Japan and West Germany, their stability is far more shaky than that of the U.S. Their own insecurities and their need for the U.S. market is the main force behind the flow of foreign investment capital to the U.S. Foreign technology, as some observers point out, is diffusing quickly to the U.S. But how the system shakes out during the 1980's, especially in the face of the rising tide of the Moslem world and the internal troubles besetting the Soviet Union is really anyone's guess. The very idea of competition over commercial property and profits may be going out of style in a world more and more interdependent. One doesn't trade in order to compete.

For example, foreign investment capital is practically surging into the U.S. from abroad. The U.S. semiconductor industry, once a scattering of relatively small companies bent on taking risk simply for the excitement of pushing back frontiers, is now being swallowed up by big foreign equipment makers. The consensus seems to be that the trend is bad for innovation in semiconductors but good for the information processing and computer industries. Equipment costs will continue to go down and technology will continue to spread across borders in healthy amounts as a consequence. Foreign countries are buying into U.S. know-how and are beginning to set up manufacturing facilities in the U.S.

In surveying global industrial activity, in fact, one comes away with the feeling of the awesome speed and volume of international technological investment. Some examples:

- International Telephone & Telegraph plans closing two unprofitable color television plants in Britain.
- Boeing plans to spend $300 million in Britain during the 1980's.
- Fujitsu, Japan's leading com-

Technological intensity of U.S. industry has declined from 1957–73 period to 1974–78

	1957–73			1974–78		
	Technology-intensive industries[a]		Nontechnology-intensive industries[b]	Technology-intensive industries[a]		Nontechnology-intensive industries[b]
	Total[a]	Chemicals and allied products		Total	Chemicals and allied products	
INDICATORS OF TECHNOLOGICAL INTENSITY						
Expenditures on R&D, all sources of funds as % of gross product originated (value added) average	14.4%	9.4%	1.3%	13.2%	9.6%	1.5%
Employment of scientists and engineers in functions other than R&D as % of total employment, average	3.5	5.6	0.8	2.8	4.5	0.8
Employment of craftsmen as % of "operatives and laborers" (census terms)	52.5[c]	42.8[c]	33.5[c]	49.8[d]	53.6[d]	38.0[d]
ECONOMIC PERFORMANCE						
Average annual growth in real output, % per year	5.5	6.0	3.8	2.7	2.4	1.1
Average annual growth in employment, % per year	1.5	1.5	0.8	1.1	1.0	−0.3
Average annual growth in real output per person employed (productivity), % per year	4.0	4.5	2.9	1.6	1.4	1.4
Average annual increase in inflation (increase in implicit price deflator), % per year	0.9	−0.3	1.6	7.4	7.9	7.9
Average annual foreign trade balance, $ billions	−$8.1	+$1.7	−$4.0	+$23.1	+$4.2	−$15.8

a Includes chemicals, nonelectrical machinery, electrical machinery and equipment, transportation equipment and missiles, and instruments and controls. b Comprises all industries not listed as technology-intensive, most notably textiles, apparel, iron, steel and nonferrous metals, and furniture. c Average for 1960–70. d 1976. **Source:** Prepared for C&EN by Michael Boretsky of the Department of Commerce. Based on data from the Bureau of Economic Analysis, Bureau of Census, Bureau of Labor Statistics, and National Science Foundation

puter manufacturer, studies the feasibility of a joint-marketing venture with TRW.

• Philips of the Netherlands expands and restructures its Japanese marketing operations to prepare for introducing its video-disk equipment there in 1981.

• Kuwait and Bahrain establish Bahrain-Kuwait Petrochemical Industries Co. in the first joint industrial venture between two Persian Gulf states.

The sheer volume and diversity of such news is dazzling and one cannot help but conclude that the competition is overpowering.

Whatever the merits of the Baruch exercise, the federal system, which is to say the people of the U.S., seems poised to draw on that reservoir of U.S. inventiveness—a force author Max Lerner labeled "The Underground River," in an essay written almost two decades ago. It is at once a corporate Main Street and counterculture phenomenon—goals for the era of international technology transfer as well as for the Age of Aquarius. The common theme is somehow a pairing of economics and the true nature of wealth.

So what should we make of all this stirring? What sort of a technology policy is being born in laboratories as well as in farms, towns, and co-ops? How can the notion of private intellectual property—technology under capitalism—be reconciled with the free flow of knowledge in a world at the brink of panic? Baruch hasn't addressed this. His theme, in a way, is to stem the tide of competition. Maybe author Gary Wills says it best in his book, "Inventing America," about Jefferson's philosophical groundings.

Jefferson felt, according to Wills, that all new gadgets simply re-exemplified the great Newtonian laws, that all "curious" mechanisms were little orreries (mechanical models of the planetary system) of nature.

"This explains," says Wills, "Jefferson's opposition to long or rigorous patent rights. No one can truly 'own' the 'invention' of things that work, since no one can own Nature, and all things work by the laws of Nature and of Nature's God. Jefferson was opposed to the individualist vision of private enterprise. All enterprise is public, is common. Not only does the earth belong to the living. So do all the forces driving the earth."

All this may appear far afield from the meager beginnings of national innovation policy that could die in months. But the notion of Jefferson's idea of mechanical gadgets being orreries and thus belonging to nature bears curious resemblance to the theology of Islam, a religion causing so much trouble for the U.S. today, and perhaps the Soviet Union tomorrow.

Baruch and Press would sound hollow to even the most moderate of ayatollahs, or to a more neutral sect of more spiritual Moslems known as Sufis, who believed technology was to be used not to master nature but to live with it. But one would have hoped that Baruch and Press would have paid attention to tides instead of waves. One suspects that much bigger things are going to drive human technics than a Press/Baruch perception of wealth and machines born somewhere in Victorian England.

A 3M Co. executive told C&EN recently: "We're becoming a have-not nation by our own hand. I'm not worried about 3M because we're already 46% offshore. But here in this country we're afraid to take risks for fear of being penalized by the regulators. Or take Three Mile Island. If that is a risk, I'll take that kind any day of the week.

"But you know, somewhere in the body of the American people there is a great pool of common sense. Somewhere down the line I'm hoping it will emerge again." □